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(54) Title: POTATO FLAKES FOR FABRICATED POTATO CHIPS, MADE WITH BY-PRODUCTS FROM FRENCH FRY MANUFACTURE ('NUBBINS' AND 'SLIVERS')

(57) Abstract

This invention provides a method of making superior potato flakes with slivers and nubbins. The flakes are used in a process for manufacturing fabricated potato chips. The potato flakes are made from 5 % to 100 % slivers and nubbins and have from about 16 % to about 26.5 % amylose; a water absorption index of from 6.7 to about 9.5 g of water per g of flakes (g/g); and a potato dough sheet strength of from 140 to 250 grams force (gf).

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POTATO FLAKES FOR FABRICATED POTATO CHIPS, MADE WITH BY-PRODUCTS FROM FRENCH FRY MANUFACTURE ('NUBBINS' AND 'SLIVERS')

TECHNICAL FIELD

This invention relates to potato flakes made from nubbins and slivers and snack food doughs made from these potato flakes.

BACKGROUND OF THE INVENTION

A wide variety of starch and protein-based snack food products are presently available to the consumer. Many of these products are in the form of chips, strips, and extruded tubular pieces.

Potato flakes, snack food sheeting dough and snack food products, per se, are well known in the art. Potato flakes, doughs and snack food products can be made according to a number of known processes including those discussed in U. S. Patent No. 2,759,832 to Cording (assigned to United States of America, Secretary of Agriculture), issued Aug. 21, 1956; 2,780,552 to Willard, issued February 5, 1957; and 2,787,553 to Cording, issued April 2, 1957. Potato granules can also be made according to known processes, including those described in U. S. Patent Nos. 2,490,431 to Greene et al., issued December 6, 1949, and 2,520,891 to Rivoche, issued August 29, 1950. Potato flakes are made by drum drying cooked mashed potatoes to a thin sheet which is then ground to a desired fineness.

However, there are still many problems associated with making potato flakes that are suitable for making snack food doughs and snack food products. This is particularly true in making potato flakes that are used for making fabricated potato chips.

Variations in potato flakes cause many problems and account for costly manufacturing processing breakdowns and waste of time and materials.

In the production of frozen French fries potato pieces called slivers (thin slices) and nubbins (short or broken pieces) are separated from the products after the potato is cut into French fry strips. The equipment usually used for this purpose consists of a rotating reel or a shaker screen having slots through which the slivers fall as they pass through the reel or over the screen bed. Converted bean graders are also used to eliminate slivers. Nubbins can be separated by a vibrating screen after the slivers are removed. In this case, the diameter of the holes in the screen correspond to the length of the short pieces or nubbins to be separated. The separated pieces are diverted to the co-product processing lines. They are used to make diced potatoes, hash browns products or mashed potatoes.

Up to now those skilled in the art were skeptical that nubbins and/or slivers could be used to make good quality potato flakes for fabricated potato chip making.

It is therefore an process of the present invention is the use of these flakes in a fabricated chip dough. This dough is formed from a combination of potato flakes, water, hydrolyzed starches, emulsifier, and optional ingredients

TO BE DESCRIBED

r. The composition of this dough has two significant effects. One relates to the ability to process the dough into a sheet from which snack pieces of predetermined shape and size are subsequently formed. The dough pieces are then fried to form thin, crisp, shaped snack potato flakes have from about 16% to about 26.5% amylose; a water absorption index of from 6.7 to about 9.5 g of water per g of flakes (g/g); and a potato dough sheet strength of from 140 to 250 grams force (gf).

Another aspect a process of this invention comprises the steps of:

(a) forming a sheetable dough comprising:
- from about 50% to about 70% of a starch based flour comprising the potato flakes of this invention;
- at least about 3% hydrolyzed starches having a DE of from about 5 to about 30;
- from about 0.5% to about 6% of emulsifier; and
- from about 20% to about 46.5% added water;

(b) forming the dough into a sheet;

(c) cutting snack pieces from the sheet; and

(d) frying said snack pieces in a fat or in a nondigestible fat or mixtures thereof.

Any suitable frying process can be used. An enabling disclosure of a frying process for potato chips is disclosed in commonly assigned International Application WO 94/23592, published 27 October 1994, incorporated herein by reference.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is a dough sheet strength test graph of a dough made with potato flakes of this invention.

Figure 2 is a sheet strength test graph of an inferior dough made with unacceptable potato flakes.

Photographs 3 and 4 are photomicrographs of potato flake cells and unacceptable flakes at 64X enlargement.

DETAILED DESCRIPTION

This invention provides potato flakes made from slivers and nubbins, as part or all of the potato ingredient. The flakes are used in a process for manufacturing fabricated potato chips. The

potato flakes are made from 5% to 100% slivers, nubbins and mixtures thereof and 0% to 95% other potato pieces. The flakes are characterized by having from about 16% to about 26.5% amylose (%A); a water absorption index (WAI) of from 6.7 to about 9.5 g of water per g of flakes; and a potato dough sheet strength of from 140 to 250 grams force (gf).

The potato flakes generally have from about 5% to about 10% moisture.

When more work is applied to making the dough as in the case of a large scale manufacturing operation, the sheet strength values can increase by a factor of 1.5 to 2.5. For the purposes of the sheet strength value used to characterize the flakes, the test method provided herein is used.

A process for making potato flakes is disclosed below. These potato flakes can be made using standard potato flake making equipment such as a twin or single screw cooker. The potato slices, nubbins and slivers are cooked under pressure in the presence steam. The cooking process removes starches and sugars from the potatoes as well as cooks the potato pieces. The nubbins and slivers are mixed together with potato slices in the cooking process. Generally from 5% to 100% nubbins and slivers are used and from 0% to 95% potato slices are used. Preferably from 50% to 90% nubbins and slivers are used.

Raw or blanched potato slices and nubbins and slivers are used. Generally the nubbins and slivers will be blanched since they are made in standard french fry making process. For making potato slices, potatoes are washed and sliced to a thickness of between 0.25 to 0.75 inches, preferably from 0.3 to 0.7 inches and most preferably from 0.35 to 0.65 inches. The nubbins and slivers size will vary but generally will be smaller than conventional french fries, shoestring fries or other frozen French fry processing operation.

The raw potatoes are blanched in a conventional manner. Usually they are heated to about 71°C to 74°C for about 20 minutes and then cooled to below about 21°C. This is usually done by a cold water wash.

The level of slivers and nubbins and the thickness of the potato slices affects the cooking requirements and evenness of cooking of the potato material, as well as the amount of starch and sugar leached from slices. The ratio of nubbins to slivers is not essential and any mix of these potato materials can be used.

<u>Cooker residence time, pressure, and steam distribution.</u>

The cooking time, pressure, and steam distribution of the cooker will affect how well and how evenly the slices are cooked. The potato pieces are cooked in a conventional cooker, preferably a single screw or twin screw cooker. The cooker uses steam under pressure.

The steam pressure is from about 2 to about 20 psig (pounds per square inch gauge), preferably from 3 to 18 psig and most preferably from 4 to 15 psig. The potatoes are cooked from about 15 to about 65 minutes, preferably from about 16 to about 25 minutes.

The potatoes are mashed as the end of the cooking step. A combined cooker masher can be used or a separate masher unit is used. A wet potato mash is made.

Additives are added to the wet mash. Various stabilizers and preservatives are usually employed to improve the stability and texture of the flakes. For example, from about 150 to about 200 parts per million (p.p.m.) of sulfite is provided in the dry product. This is added to the wet mash usually as dry sodium sulfite and sodium busulfite and protects the flakes from darkening during processing and subsequent storage. Antioxidants such as BHA (2 and 3-tert-butyl-4-hydroxy-anisole) and BHT (3,5-di-tert-butyl-4-hydroxytolune) are added in amount up to a total of about 10 p.p.m. to prevent oxidative deterioration. Citric acid is generally added in a quantity sufficient to give about 90 p.p.m. in the dried product to prevent discoloration caused by the presence of ferrous ions. Monoglycerides such as glycerol monopalmitate or glycerol monostearate are also added to the wet mash prior to drying in an amount ranging from about 0.4% to about 1% by weight to improve the texture of the constituted mash.

Potato flakes typically have a moisture content of about 7% by weight and have their potato cells substantially intact with a minimum of free starch.

<u>Emulsifier</u>

The amount of emulsifier added will affect the performance of the dough made and the finished snack food product. The emulsifier interacts with the free starch of the dehydrated flakes.

The preferred emulsifier is a distilled monoglyceride and diglyceride of partially hydrogenated soybean oil. Other suitable emulsifiers can be used. Generally from about 0.1% to 1% emulsifier (dry weight of potato flake) is added to the wet mash or cooked potatoes. Preferably the level of emulsifiers in the final flake is from 0.1% to about 0.5%.

The wet mash is dried using conventional drum dryers. See Talburt, W.F. editor, <u>Potato Processing</u>, 4th Ed, pp 549-575 (Van Nostrand Rheinhold, New York, 1987) incorporated by reference. The drying method is not critical.

The dried mash forms a sheet which is removed from the rolls or drums and then ground to form the potato flakes.

The speed at which the drum dryers are turned will affect the level of moisture in the finished flake, as well as the overall rate of flake production.

The method of making potato flakes of this invention requires that the flakes be processed so that they have the physical and chemical properties described below.

Tables 1-6 show some preferred ranges for two types of potato flakes. Type I is for making a low fat snack food potato chip and Type II is for making a regular potato chip snack food.

The low fat potato chips have a total fat content of from about 19% to about 29% fat, preferably from about 23% to about 25% fat.

Regular snack food potato chips have a total fat content of from about 29% to about 38% fat, preferably from about 33% to about 35%.

While not being bound to any theory, the follow disclosure contains some theory on the operability of these flakes

WATER ABSORPTION INDEX (WAI)

Water Absorption Index (WAI) is a physical parameter that indicates the capacity of a material such as potato flakes to hold water. It is directly proportional to the degree of cook. It theoretically correlates to the physical damage of the potato cells in the potato flakes during the process. WAI also correlates in a small degree to the surface area exposed as the result of grinding. In the process of making fabricated potato chips, the WAI is believed to correlate to the level of fat that is absorbed in the finished product during the frying process. Table 1 shows preferred WAI ranges for type I and II potato flakes of this invention.

Table 1 - WAI

Type	I	II
Range	6.7 - 8.3	7.7 - 9.5
Preferred range	7 - 8	8 - 9
More preferred range	7.2 - 7.8	8.2 - 8.8

AMYLOSE – A (%)

The potato flake composition comprises from about 16% to about 26.5% amylose (A%). Preferably the flakes have from 17 to 25.5% amylose and most preferably from about 18% to about 24.5% The percent of amylose is a measurement of the free starch in the potato flake composition. The level of amylose is adjusted by selective cooking and controlling the drying and grinding steps of the potato flaking process. As cooking time is increased the level of amylose increases.

Table 2 shows preferred amylose ranges.

Table 2 - Amylose %

TYPE	I	II
Range	16 - 20	20 - 26.5
Preferred range	17 - 19.5	21 - 25.5
More preferred range	18 - 19	22.5 - 24.5
Examples	19	24

SHEET STRENGTH

This test is a measurement of the force needed to break a 0.635 mm dough sheet made with the potato flakes. A fixed weight plunger moves at a fixed speed downward onto the center of the dough sheet breaking the sheet. The sheet strength measurement is expressed as grams force (gf). Table 3 shows two preferred sheet strength ranges.

Table 3 -Sheet Strength Ranges

TYPE	I	II
Range	140 - 200	170 - 250
Preferred range	155 - 190	180 - 240
More preferred range	165 - 185	190 - 220

On a large scale, the full potato chip formula is used and the dough mixing and milling are more intense. More work input is used to mix and mill the dough and the sheet strength of the dough is about 1.5 to 2.5 times that of the same dough tested on a small scale.

HOT PASTE VISCOSITY (HPV)

The hot paste viscosity is a measurement of the highest viscosity peak of a starch material after applying high temperatures under constant shear rate. The initial part of the viscosity profile curve, strongly correlates to Water Absorption Index. For native starches the hot paste viscosity profile will show a maximum peak viscosity in the range of the gelatinization temperature. In the case of potato flakes, as well as other partially gelatinized starches, the hot past viscosity is used as an indication of the degree of cooking and cell damage. The higher HPV profiles indicate more cell damage due to overcooking in the flaking process. Large differences between hot paste viscosity and cold paste viscosity indicates uneven cooking.

Table 4 - HPV Ranges

Type	I	II
Range	100 - 280	240 - 320
Preferred range	150 - 250	260 - 300
More preferred range	190 - 230	275 - 290

COLD PASTE VISCOSITY (CPV)

Cold paste viscosity is a measurement of the highest peak viscosity of a starch material at low temperatures under constant shear rate. The cooling part of the viscosity profile curve, strongly correlates to the free amylose level in the sample. For overcooked starches the CPV increases. The cooling curve is an indication of the starch retrogradation happening during the process. Cold paste viscosities are reported in Brabender Units as are hot paste viscosities.

Table 5 - CPV

Type	I	II
Range	100 - 200	120 - 230
Preferred range	120 - 180	170 - 220
More preferred range	140 - 160	150 - 210

In the process of making fabricated chips, potato flakes that have low hot paste viscosities and low cold paste viscosities will make a very stable dough notwithstanding changes in water temperature in the manufacturing operation. The difference between hot and cold paste viscosities should be less than 100, preferably less than 80.

PERCENT BROKEN CELLS

Microscopic Evaluation is the measurement of three parameters by using a light microscope: percent of broken cells, degree of potato cells swelling (size), and the level of cell separation. (See Photos and U. S. Patent 3,054,683, the method of measurement is incorporated herein by reference). These three parameters are an indication of degree of cook, starch damage during grinding, potato solids content, potato mineral composition, potato variety, etc.

Table 6 - % Broken Cells

Type	I	II
Range	40 - 60	40-60
Preferred range	42 - 58	42-58
More preferred range	45 - 55	45-55

FLAKE PARTICLE SIZE

Particle size distribution is a measurement of the granulation of potato flakes. It is weight base distribution of flakes based on size of particles. Normally, it is described by a set of US

Standard mesh sizes. Preferably from 20% to 60% of the flakes remain on a #40 US screen (420 microns).

MOISTURE OF FLAKES

The level of moisture on the dry flakes is from 5% to 10%, preferably from 6% to 8%, more preferably from 6.5 to 7.5.

Snack Food Dough Formation

A particularly important aspect of the process of the present invention is the use of these flakes in a fabricated chip dough. This dough is formed from a combination of potato flakes, water, hydrolyzed starches, emulsifier, and optional ingredients to be described hereinafter. The composition of this dough has two significant effects. One relates to the ability to process the dough into a sheet from which snack pieces of predetermined shape and size are subsequently formed. The dough pieces are then fried to form thin, crisp, shaped snack products. The other effect of the dough composition relates to the textural and flavor features of the resulting fried snack product. Snack products prepared according to the process of the present invention have a relatively light, crunchy texture.

As used herein, the term "crunchy texture" refers to a snack that exhibits a crisp and crunching sensation for the first of several chews.

An important component of this dough is a starch based flour comprising potato flakes of this invention. Suitable sources of potato flour include the dehydrated potato flakes and limited amounts, 5-15%, potato granules, mashed potato materials, and dried potato products. Limited amounts of other tuber and grain flours such as tapioca, peanut, wheat, oat, rice, corn meal, corn flour and soy meal can be used in the dough. These starch based flours can be blended to make snacks of different composition and flavor. Suitable starches can be used in combination with the potato flakes. Examples of such materials are potato starch, tapioca starch, cornstarch, oat starch, rice starch and wheat starch. Most preferably these starches are cooked so the starch has gelatinized and then are dried and milled to make a flour. These starches are called pregelatinized starches. For example, potato flour is at least 90% pregelatinized starch. Preferred flours contain at least 80% pregelatinized starch. Potato flakes generally contain about the same level of pregelatinized starch than potato granules. From 80:20 to 95:5 potato flakes to potato granules can be used. It is understood that other sources of pregelatinized starches other than potato flakes and granules can be used. Generally the flour comprised from about 50% to about 90% potato flakes.

Preferably the potato flake material which is used as the predominant potato ingredient has a WAI of between 7 and 9 and that of the other starch ingredient has a WAI of between 2 and 6. Preferably the WAI of all the ingredients is from 7 to 8.

The dough can contain other ingredients. Hydrolyzed starches are included in the dough in an amount of at least about 3%, with a usual range of from about 3% to about 15%. Preferably, hydrolyzed starches are included in an amount of from about 5% to about 12%.

As used herein, the term "hydrolyzed starches" refers to oligosaccharide-type materials that are typically obtained by acid or enzymatic hydrolysis of starches, preferably corn starch. Suitable hydrolyzed starches for inclusion in the dough include maltodextrins and corn syrup solids. The hydrolyzed starches for inclusion in the dough have Dextrose Equivalent (D.E.) values of from about 5 to about 30, preferably from about 10 to about 20. Maltrin™ M050, M100, M150, M180, M200, and M250 (available from Grain Processing Corporation, Iowa) are preferred maltodextrins. The D.E. value is a measure of the reducing equivalence of the hydrolyzed starch referenced to dextrose and expressed as a percent (on a dry basis). The higher the D.E. value, the more reducing sugars are present.

Hydrolyzed starches are a key ingredient for the processability of the doughs of the present invention which have relatively low water levels. In the absence of hydrolyzed starches, low moisture levels in the dough can prevent formation of a continuous, smooth extensible dough sheet and can hinder subsequent expansion of the dough pieces during frying, even if the dough can be sheeted. It also affects the elasticity of the dough. In addition, low moisture doughs tend to produce a harder and more brittle texture in the resulting snack products.

Modified starches can also be used in this composition. As used herein the term, "modified starches" refers to chemically treated type materials which have unique functionality, modified starches are included in the dough in an amount of at least 0.5%, with an usual range of from about 1% to about 3%, preferably from about 1.5% to about 2.5%. Kerr and Cleveland (U.S. Patent No. 3,021,296) described the cross-linking of granular starch in an aqueous alkaline suspension of sodium trimetaphosphate. Caldwell (U.S. Patent No. 2,461,139) and Wurzburg (U.S. Patent No. 2,935,510) described a process to cross-link starch using adipic acid. Cross-linking affects directly the rheological behavior of the starch, altering the water absorption capacity of the molecules.

There are a number of patents and publications in the literature relating to modification of starch by esterification and etherification reaction. Most commercial modified starch products have low degree of substitution (DS) levels designed to alter their solution properties for food applications or adhesion to paper. Acetylated starches, for example, have been known for more than 100 years. Starch acetates ranging from about 0.3 to about 1 DS are typified by water solubility. Starch esters which are commercially available for consumption, used for example in salad dressings, have a degree of substitution which typically is lower than 0.1 DS. For example, starch derivatives are cleared for food use by the U.S. Food and Drug Administration (FDA) up to a 4% treatment level, which is equivalent to 0.07 DS.

The modified starch can be blended with various types of starches, such as regular corn starch which contains about 75% amylopectin (higher molecular weight branched starch polymer) and 25% amylose (lower molecular weight linear starch polymer), as well as hybrid corn starch products containing more than 50% amylose, sold by National Starch and Chemical Company Corporation and American Maize Products Company. Various other starches, such as potato starch, tapioca starch, rice starch, wheat starch, cassava starch, and other starches familiar to those skilled in the art can be utilized in accordance with the present invention.

The modified starch compositions, preferably have a degree of substitution preferably from 1.0 to 2.0 DS. The most preferred compositions ranges from 1.2 to 1.7 DS.

Another important characteristic of the dough of the present invention is its water content. As used herein, the term "added" refers to water which has been added to the dry dough ingredients. Water which is inherently present in the dry dough ingredients, such as in the case of the sources of flour and starches, is not included in the added water. The level of water in potato flakes and starches is usually from about 3% to about 8%. However, if the maltodextrin or corn syrup solids are added as a solution or syrup, the water in this syrup or solution must be accounted for as "added water".

The doughs of the present invention can comprise from about 20% to about 40% added water. Preferably, these doughs comprise from about 23% to about 35% added water. This low level of water in the dough along with the addition of hydrolyzed starches provides doughs which can form cohesive sheets. In addition, the low moisture level of the doughs of the present invention are important in reducing the oil content of the final fried snack pieces. The total moisture content of the dough can range from about 25% to about 55% by weight (including the moisture content of the potato flakes), and is preferably from about 35% to about 45%, the balance of the dough comprising potato flakes (which have been dehydrated by the water) and other potato chip components.

In preparing the above described doughs, the water is added to the dehydrated potato flakes. Said water is preferably heated, but can be mixed in at room temperature.

Emulsifiers can be added to the dough as a blend with a fat or a non-digestible fat. Alternatively, the same emulsifier can be incorporated into the potato flake. The amount of emulsifier in the dough is from about 0.5% to about 6% by weight, preferably from about 1.0% to about 3%, and most preferably from about 1.5% to about 2.5%. Emulsifiers are used as a sheeting aid to avoid overworked sticky doughs and to reduce puffing and blistering in the fried product. Lower moisture doughs, when fried, typically yield harder snack products. To make products with textures similar to those made from higher moisture doughs, the level of emulsifier is typically reduced.

The emulsifier is added to the dough system prior to sheeting as a processing aid to prevent sticking of the dough to the sheeting mill rolls and to impart extensibility to the sheet to

prevent the sheet from tearing. The emulsifier can be dissolved a fat or in a polyol fatty acid polyester, preferably a sucrose fatty acid ester such as olestra. The emulsifier comprises from about 10% to about 50% of the fat composition which is added. The composition can contain from 20% to about 30% emulsifier and from about 70% to 80% sucrose fatty acid polyester or any other suitable oil.

Suitable emulsifiers include mono- and diglycerides, diacetyl tartaric acid esters and propylene glycol mono- and diesters and polyglycerol.

Polyglycerol emulsifiers such as monoesters of polyglycerols, preferably hexapolyglycerols can be used.

Vitamins, salt, flavorings, flavor potentiators, and/or seasonings can also be optionally included in the dough or sprinkled or sprayed on the surface of the snack after frying.

The dough can be prepared by any suitable method for combining the previously described ingredients. Typically, a loose, dry dough is prepared by thoroughly mixing together the flours and/ or starches and emulsifier combination. A water preblend of flavoring (optional), hydrolyzed starches, sucrose and/or salt are separately mixed to obtain the previously defined hydrolyzed starch and water levels. The water preblend is then added to the flour and emulsifier blend. Preferred devices for mixing together these dough ingredients are conventional mixers. Hobart™. mixers are used for batch operations and Turbolizer™ mixers can be used for continuous mixing operations. However, extruders can also be used to mix the dough and to form the sheets or shaped pieces.

The emulsifier works via several mechanisms. The first is as a coating of the flour in the mixer just prior to the addition of the water. This limits the moisture absorption of the flour producing a "short" dough.

The second function of the emulsifier is to create a dispersion of fat and moisture droplets through the dough. Both of these mechanism tend to limit the adhesiveness of the starch contained in the flour, preventing permanent adhesion to the sheeting rolls.

The capability of the emulsifier to mix thoroughly with the other ingredients and to readily disperse throughout the dough during mixing and milling are very important.

B. Sheeting, Snack Piece Formation and Frying

Once prepared, the dough is then formed into a relatively flat, thin sheet. Any method suitable for forming such sheets from starch based doughs can be used. For example, the sheet can be rolled out between two counter rotating cylindrical rollers to obtain a uniform, relatively thin sheet of dough material. Any conventional sheeting, milling and gauging equipment can be used. The mill rolls should be heated to about 90°F (32°C) to about 135°F (57°C). In a preferred embodiment, the mill rolls are kept at two different temperatures, with the front roller being cooler than the back roller.

Doughs of the present invention are usually formed into a sheet having a thickness of from about 0.015 to about 0.10 inches (from about 0.038 to about 0.25 cm), and preferably to a thickness of from about 0.05 to about 0.10 inches (from about 0.013 to about 0.025 cm), and most preferably from about 0.065 in to about 0.08 in (1.65 to 2.03 mm). For rippled chips the preferred thickness is about 0.75 in or 1.9 mm. The dough sheet is then formed into snack pieces of a predetermined size and shape. These snack pieces can be formed using any suitable stamping or cutting equipment. The snack pieces can be formed into a variety of shapes. For example, the snack pieces can be in the shape of ovals, squares, circles, a bowtie, a star wheel, or a pin wheel. The pieces can be scored to make rippled chips as described in WO 95/07610, Dawes et al., January 25, 1996.

The snack pieces are fried. Preferably the snacks are prepared by a continuous frying method and are constrained during frying. An apparatus as described in U.S. Pat. No. 3,626,466 (Liepa, 1971) can be used. This patent is incorporated herein by reference. The dough pieces are cut from the sheet, shaped using a movable, apertured mold half to shape the cut dough pieces and then held during subsequent frying by a second apertured mold half. A reservoir containing a frying medium is used. The shaped, constrained pieces are passed through the frying medium until they are fried to a crisp state with a final moisture content of about 0.5% to about 4% water, preferably 1 to 2%.

Continuous frying or batch frying of the snack pieces in a non-constrained mode is also acceptable. In this method the pieces are immersed in the oil on a moving belt or basket.

If desired, the snack pieces can be fried to moisture contents of 10% or less and then heated with hot air, superheated steam or inert gas to lower the moisture level to 4% or less. This is a combined frying/baking step.

The frying can be done in convention triglyceride oils, or, if desired, the frying can be done in low calorie fat-like materials such as those described in U. S. Patent Nos. 3,600,186 to Mattson et al. (assigned to The Procter & Gamble Co), issued May 12, 1970; 4,005,195 to Jandacek (assigned to The Procter & Gamble Co.), issued January 25, 1977; 4,005,196 to Jandacek et al. (assigned to The Procter & Gamble Co.), issued January 25, 1977; 4,034,083 to Mattson (assigned to The Procter & Gamble Co.), issued July 5, 1977; and 4,241,054 to Volpenhein et al. (assigned to The Procter & Gamble Co.), issued December 23, 1980, all incorporated by reference herein. The terms "fat" and "oil" are used interchangeably unless otherwise specified. The terms "fat" or "oil" also refer 100% non-toxic fatty materials having properties similar to triglycerides. The terms "fat" or "oil" in general include fat-substitutes, which materials may be partially or fully nondigestible.

The term "non-digestible fat" refers to those edible fatty materials that are partially or totally nondigestible, e.g., polyol fatty acid polyesters, such as olestra.

The preferred fat substitute are fatty materials having properties similar to triglycerides such as sucrose polyesters. OLEAN,™ a preferred fat substitute, is made by The Procter and

Gamble Company. These preferred nondigestible fat or oil substitute compositions are described in Young; et al., U.S. Patent 5,085,884, issued February 4, 1992, and U. S. Pat. 5,422,131, issued June 6, 1995 to Elsen et al.

By "polyol" is meant a polyhydric alcohol containing at least 4, preferably from 4 to 11 hydroxyl groups. Polyols include sugars (i.e., monosaccharides, disaccharides, and trisaccharides), sugar alcohols, other sugar derivatives (i.e., alkyl glucosides), polyglycerols such as diglycerol and triglycerol, pentaerythritol, sugar ethers such as sorbitan and polyvinyl alcohols. Specific examples of suitable sugars, sugar alcohols and sugar derivatives include xylose, arabinose, ribose, xylitol, erythritol, glucose, methyl glucoside, mannose, galactose, fructose, sorbitol, maltose, lactose, sucrose, raffinose, and maltotriose.

By "polyol fatty acid polyester" is meant a polyol having at least 4 fatty acid ester groups. Polyol fatty acid esters that contain 3 or less fatty acid ester groups are generally digested in, and the products of digestion are absorbed from, the intestinal tract much in the manner of ordinary triglyceride fats or oils, whereas those polyol fatty acid esters containing 4 or more fatty acid ester groups are substantially non-digestible and consequently non-absorbable by the human body. It is not necessary that all of the hydroxyl groups of the polyol be esterified, but it is preferable that disaccharide molecules contain no more than 3 unesterified hydroxyl groups for the purpose of being non-digestible. Typically, substantially all, e.g., at least about 85%, of the hydroxyl groups of the polyol are esterified. In the case of sucrose polyesters, typically from about 7 to 8 of the hydroxyl groups of the polyol are esterified.

The polyol fatty acid esters typically contain fatty acid radicals typically having at least 4 carbon atoms and up to 26 carbon atoms. These fatty acid radicals can be derived from naturally occurring or synthetic fatty acids. The fatty acid radicals can be saturated or unsaturated, including positional or geometric isomers, e.g., cis- or trans- isomers, and can be the same for all ester groups, or can be mixtures of different fatty acids.

Liquid non-digestible oils have a complete melting point below about 37°C include liquid polyol fatty acid polyesters (see Jandacek; U.S. Patent 4,005,195; Issued January 25, 1977); liquid esters of tricarballylic acids (see Hamm; U.S. Patent 4,508,746; Issued April 2, 1985); liquid diesters of dicarboxylic acids such as derivatives of malonic and succinic acid (see Fulcher; U.S. Patent 4,582,927; Issued April 15, 1986); liquid triglycerides of alpha-branched chain carboxylic acids (see Whyte; U.S. Patent 3,579,548; Issued May 18, 1971); liquid ethers and ether esters containing the neopentyl moiety (see Minich; U.S. Patent 2,962,419; Issued Nov. 29, 1960); liquid fatty polyethers of polyglycerol (See Hunter et al; U.S. Patent 3,932,532; Issued Jan. 13, 1976); liquid alkyl glycoside fatty acid polyesters (see Meyer et al; U.S. Patent 4,840,815; Issued June 20, 1989); liquid polyesters of two ether linked hydroxypolycarboxylic acids (e.g., citric or isocitric acid) (see Huhn et al; U.S. Patent 4,888,195; Issued December 19, 1988); liquid esters of epoxide-extended polyols (see White et al; U.S. Patent 4,861,613; Issued August 29, 1989); liquid

polydimethyl siloxanes (e.g., Fluid Silicones available from Dow Corning). Solid non-digestible fats or other solid materials can be added to the liquid non-digestible oils to prevent passive oil loss. Particularly preferred non-digestible fat compositions include those described in US 5,490,995 issued to Corrigan, 1996, US 5,480,667 issued to Corrigan et al, 1996, US 5,451,416 issued to Johnston et al, 1995 and US 5,422,131 issued to Elsen et al, 1995. US 5,419,925 issued to Seiden et al, 1995 describes mixtures of reduced calorie triglycerides and polyol polyesters that can be used herein. However the latter composition may provide more digestible fat.

Other ingredients known in the art may also be added to the edible fats and oils, including antioxidants such as TBHQ, chelating agents such as citric acid, and anti-foaming agents such as dimethylpolysiloxane.

The snack pieces are fried at temperatures between about 300°F (148°C) and about 450°F (232°C). The exact fry time is controlled by the temperature of the oil and the starting water content. The fry time and temperature is easily determined by one skilled in the art.

The snack products made from this process typically have from about 20% to about 38% fat. Preferably, the fried snacks will have from about 23% to about 32% fat content. If a higher fat level is desired in the snack product to further improve the lubricity of the snack, oil can be sprayed onto the snack product when it emerges from the fryer, or when it is removed from the mold used in constrained frying. Preferably the oils for spraying will have an iodine value greater than 75, and most preferably above 90. Oils with characteristic flavors or highly unsaturated oils can be sprayed on the snack product. Oils with added flavors can be used. These include butter flavored oils, natural or artificial flavored oils, herb oils and oils with garlic or onion flavors added. This is a way to introduce a variety of flavors without having the flavor undergo browning reactions during the frying. It also avoids adding the flavor to the dough and having the flavor react with or leach into the oil during the frying process. This method can be used to introduce healthier oils which would ordinarily undergo polymerization or oxidation during the heating necessary to fry the snacks.

Oil spray can be used to increase the oil content from the 20% to 38% fat content as the snack product emerges from the fryer to as high as 44% oil. Thus a snack product having from 30% to 44% can be made using this additional step.

EXAMPLE I

The following examples 2 and 3 are potato flakes made from slivers and nubbins. Example I does not use slivers and nubbins.

Process Parameters	Example 1	Example 2	Example 3
% Slivers & nubbins	0	30 - 40	100
Cooking Pressure (PSI)	5	5	5
Cooking time (min)	19	21	23
Drum Speed (rev/sec)	10.5	10.5	10.5
Sheet Thickness (mm)	0.2	0.2	0.2

Flake Properties	Example 1	Example 2	Example 3
Moisture (%)	6.0	6.0	6.0
WAI	7.9	8.6	8.1
Amylose (%)	20	22.0	22.5
HPV (BU)*	290	----	320
CPV (BU)	200	----	220
Sheet Strength (gf)	200	217	220
Microscopic Ev.	50% broken cells	50% broken cells	50% broken cells

* Brabender Units

The flakes are made by blending the blanched slivers and nubbins with blanched potato slices. These blends are processed in conventional processing equipment to produce the flakes.

EXAMPLE II

Potato flakes are made from about 40% nubbins and slivers and 60% potato slices. They have

WAI = 8.5

Amylose = 24%

Hot Paste Viscosity = 200 BU

Cold Paste Viscosity = 200 BU

Sheet Strength = 211 gf

About 27% of these flakes have a particle size on #40 mesh screen. The flakes are used in a dough comprising 78% potato flakes, 4% Maltrin 180, a maltodextrin available from Grain Processing (Muscatine, Iowa), 9% wheat starch and 9% corn meal.

These potato flakes absorb the right amount of water to produce a fabricated chip dough containing ~30% water, which during frying is exchanged by oil. When this dough is milled no pinholes or sheet tears are apparent.

The sheet obtained from these flakes allows the process to run at higher speeds.

Another advantage of these flakes is that the stickiness of the sheet is very well controlled. This also facilitates the cutting of the sheet in individual pieces and transferring them to the fryer. The fat content of the chip is about 38%.

EXAMPLE III

A mix consisting of approximately 53.10% the potato flakes of Example 3, and 5.90% potato granules is blended with a hexapolyglycerol monoester of palmitic and stearic acids available from Lonza as HGMP and OLEAN, available from The Procter & Gamble Co., Cincinnati, Ohio. The level of the emulsifier in the dough is 0.75% and that of the OLEAN is 2.25%. Water, 32.7%, Maltodextrin having a DE of 18 available from Grain Products Corporation and sucrose (0.4%) and salt (0.4%) are mixed with the flake and emulsifier blend to form a loose, dry dough in a continuous Turbolizer® mixer with a residence time of 15 to 60 seconds.

The dough is sheeted by continuously feeding the dough through a pair of sheeting rolls forming an elastic continuous sheet without pin holes. Sheet thickness is controlled to 0.020 inches (0.05 cm). The front roll is heated to about 90°F (32°C) and the back roll is heated to about 135°F (57°C). The dough sheet is then cut into oval shaped pieces and fried in a constrained frying mold at 385°F (196°C) in OLEAN to dryness (about 12 seconds). The product is held in the molds for about 20 seconds to allow the OLEAN to drain. The resulting product has a crisp, light texture with a nondigestible fat level of about 30% to 32%. The digestible fat level from the emulsifier is less than 0.25 gm/30 gm serving.

EXAMPLES IV - VI

Examples 1V - VI are preferred dry weight potato chip formulations using modified starch, selected waxy rice flour and potato flakes which can be used to make fabricated chips as described in the process of Example III. A 15/85 blend of distilled monoglyceride/OLEAN is used as the emulsifier.

EXAMPLE IV

Potato flakes	76.5%
Potato granules	9.0%
Waxy Rice Flour	6.0%
N-Lite LP (crosslinked starch)	1.5%
Maltodextrin (DE 18)	7.0%

EXAMPLE V

Potato flakes	80.0%
Potato granules	8.5%
Cereal Crisp (High amylose corn starch)	6.0%
N-Lite LP	1.5%
Maltodextrin	4.0%

EXAMPLE VI

Potato flakes	84.5%
Potato granules	9.0%
Cereal Crisp	6.0%
N-Creamer 46 (Hydrophobic starch)	1.5%

Example IV - VI dry ingredients have WAI's of from 7 to 7.5 when made into a dough as in Example III. On a commercial scale, the doughs have a sheet strength of from 140 gf to 500 gf. The dough is cut into pieces and can be fried in cottonseed oil instead of OLEAN.

While this invention has been described as having a preferred design, the present invention can be further modified with the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.

ANALYTICAL METHODS

Water Absorption Index

In general, the "Water Absorption Index" and "WAI" refers to the measurement of the water holding capacity of any carbohydrate based material as a result of a cooking process. (See for example Anderson, R. A., Conway, H. F., Pfeifer, V. F. and Griffin, Jr., E. L., 1969, *Gelatinization of Corn Grits By Roll- and Extrusion-Cooking*. CEREAL SCIENCE TODAY; 14(1):4). This measurement is typically expressed as the ratio of mass of water held per unit mass of material. The WAI for a sample is determined by the following procedure. The weight to two decimal places of an empty centrifuge tube is determined. Two grams of dry sample (e.g., potato flakes) are placed into the tube. Thirty milliliters of water is added to the tube. The water and sample are stirred vigorously to insure no dry lumps remain. The tube is placed in a 30°C (85°F) water bath for 30 min., repeating the stirring procedure at 10 and 20 min. The tube is then centrifuged for 15 min. at 3,000 RPM. The water is then decanted from the tube, leaving a gel behind. The tube and contents are weighed. The WAI is calculated by dividing the weight of the

resulting gel by the weight of the dry sample (i.e., [weight of tube and gel] - [weight of tube] ÷ [weight of dry flakes]).

The water absorption index of the dry material correlates to performance in the snack chip process. The cooking and dehydration of potato flakes introduces changes in the potato cell physiology which affects its rehydration properties, specifically its water holding capacity.

PERCENT AMYLOSE A (%) TEST

This method is designed to measure the percentage (relative quantity) of amylose in potato flakes which is soluble in 0.1N NaOH solution under specific test conditions.

Theory

The cooking and dehydration of potato introduces changes in the starch which affect its rehydration properties. The solution properties as measured in the test are related to these rehydration properties. Flakes are stirred in a base solution at 60°C for 30 minutes, centrifuged, and the clear supernatant then reacted with iodine and analyzed spectrophotometrically. The amylose is measured as the iodine complexes at 700 nm, rather than 610 nm, to avoid the interference from the amylopectin-I_2 "complex".

Apparatus

Volumetric flakes, volumetric pipettes, balance, spectrophotometer (Beckman Model 24 or equivalent), cells (1 cm disposable, Marksman Science #1-P-10, or 1 cam sipper type Markson MB-178 or Beckman Part #579215), constant temperature bath, blender and blender jars.

Reagents

Sodium Hydroxide Solution 0.1N, Hydrochloric Acid, Iodine, Potassium Iodide, Calibration Standard (Amylose - Sigma Type III potato cat. # A-0512).

Preparation of Solutions

A. Stock Iodine Solution

Weigh 2g of Iodine and 20g of Potassium Iodide into a red 250 ml volumetric flask, and dissolve with distilled water.

B. Reagent Iodine Solution

Pipet 10 ml of the stock Iodine solution and 2 ml of concentrated hydrochloric acid into a red 1000 ml volumetric flask. Dilute to volume with distilled water.

Standard Curve Preparation Using Standard Amylose

1. Dissolve 1 g of amylose (Sigma, from potato) with 100 0.1N NaOH. Transfer entire solution into a centrifuge bottle, without rinsing. Centrifuge at 1600 rpm for 15 min.

2. Prepare three dilutions: a) 10 ml of supernatant into 100 ml of 0.1N NaOH, b) 5ml of supernatant of first dilution into 100 ml of 0.1N NaOH, and c) 50 ml of the second dilution into 100 ml of 0.1N NaOH.

<u>Sample Preparation</u>

- Obtain percent moisture in each sample. (Vacuum oven 16 hours 70°C, or 3 hr @ 130°C in an air oven).
- Weigh 0.2g of potato flakes and dissolve with 100 ml of 0.1 N NaOH solution. Turn the stirrer on high to obtain a good vortex in the liquid.
- Place samples in the 60°C water bath. Stir for 30 minutes. Remove from bath.
- Pour the entire solution into a centrifuge bottle; do not rinse. Centrifuge at 1600 rpm for 15 minutes.
- Pipet 1 ml of the supernatant into a 25 ml volumetric flask. Dilute all the volume with iodine reagent. Prepare the blank solution, using 1 ml of the 0.1N NaOH solution in a 25 ml flask. Shake well. The colorimetric determination must be made 10 - 30 minutes after mixing.

<u>Colorimetric Determination</u>

Set the wavelength to 700 nm. Zero the instrument with distilled water in the sample cell and in the reference beam. Fill the sample cell with blank solution and read against distilled water. Note this value and subtract from each sample value. In normal practice, the absorbances falls between 0.02 and 0.8 absorbance units.

<u>Calculations (using the standard amylose)</u>:

Plot a curve using g/100 ml of standard concentrations as the x axis versus the absorbance @ 700 nm as the y axis.

$$\%\ \text{Amylose} = \frac{(\text{Amylose g/100 ml}) \times 100}{\frac{(100 - \%\ \text{water}) \times (\text{Sample wt.})}{100}}$$

SHEET STRENGTH TEST

The sheet strength is determined as set forth below. The sheet strength is measured by preparing a dough comprising:

- 200g of solids
- 90g of water
- 0.5g of distilled mono and diglyceride of partially hydrogenated soybean oil emulsifier available from Quest.

The 200g solids comprise:

Potato flakes	76%	(~6.5% moisture)
Maltodextrin DE 18 (M180, Grain Processing)	7%	(~1% moisture)
Partially precooked Corn meal (PC PF 400 American Maize Products)	9%	(~8% moisture)
Wheat starch (ADM Milling Co.)	8%	(~12% moisture)

The dough is made in a small Cuisinart® mixer at low speed for 10-20 seconds. After mixing the dough is sheeted using a conventional milling machine to a thickness of 0.635 mm (22 mils). The mill rolls are usually 1.2 meter length x 0.75 diameter meter.

This test is conducted using a Texture Analyzer (TA-XT2) from Texture Technologies Corp. This equipment uses a software called XTRAD. This test utilizes a 7/16" diameter acrylic cylinder probe (TA-108), which has a smooth edge to minimize any cutting of the dough sheet. The dough sheet is held between two aluminum plates (10 X 10 cm). The aluminum plates have a 7 cm diameter opening in the center. Through this opening the probe makes contact with the sheet and pushes it downwards until it breaks. These plates have an opening in each corner to hold the sheet dough in place. Each dough sheet is pre-punched with holes to fit over the alignment pins at the corners of the plate and cut to the size (10 X 10 cm) of the plate. This provides uniform tension as the probe moves down and through the sheet. The probe travels at 2 mm/second until the dough sheet surface is detected at 20 grams of force. The probe then travels at 1.0 mm/second for up to 50 mm, a distance chosen to stretch the dough sheet until it thoroughly ruptures. The probe withdraws at 10.0 mm/second. The probe is run in a "Force vs Compression" mode, which means the probe will move downward measuring the force.

Sheet strength is the measurement of the force needed to break a dough sheet of 0.635mm. The sheet strength is read as the maximum peak force (gf) of a graph obtained from force against distance. See Figure 1 and Figure 2. Figure 1 is a sheet strength test graph of a potato dough made with the potato flakes of this invention. Figure 2 is a sheet strength test graph of potato dough made with unacceptable potato flakes.

The test is designed to measure potato dough sheet strength. All products are tested at room temperature. Sheet strength is an average of ten repetitions of each test.

HOT AND COLD PASTE VISCOSITIES

Accurately weigh 30 g of flakes on a moisture free basis and transfer quantitatively to a 600 ml beaker. Add about 400 ml of water to the flakes sample and mix thoroughly to obtain a homogeneous suspension. The dispersion is transferred to the sample cup of an amylograph and he instrument head is lowered into the operating position. Start the amylograph with the thermoregulator transport switch in the neutral position, heat off, and the cup speed at 75 rpm. Heat at a rate of 1.5°C per min until the sample reaches 90°C. The thermoregulator switch is set at neutral and held at 90°C for 10 min. This is the hot paste viscosity. Then the thermoregulator switch is changed to cool at 1.5°C per minute to 50°C. This is the cold paste viscosity. (The

Amylograph Handbook, edited by William C. Shuey and Keith H. Tipples, AACC, 1994.) Hot and cold paste viscosities are measured in Brabender Units.

PERCENT OF BROKEN CELLS TEST

The percent of broken cells in the potato flakes and the average size of the cells is determined by simple observation through the light microscope. A small amount of flakes is spread on a portaglass, and 2 -3 drops of water are added immediately. After 30 sec., the sample is ready to be observed through the light microscope (x100). The % broken cells are determined.

PARTICLE SIZE DISTRIBUTION TEST

METHOD

1. Weigh dehydrated potatoes.
2. Weigh the screens and then stack them in the following order top to bottom: U. S. #16, #20, #40, #100 and bottom pan. Pour in the dehydrated potatoes. Put the screens in a rotap unit. Turn on the rotap unit for one minute.
3. Weigh and record the total weight of potato material on the screens.

TABLE 7

POTATO FLAKES PARTICLE SIZE RANGES

Screen Size (U.S. Mesh)	Guidelines for Percent on Screen
16	1-3
20	1-3
40	20-60
100	60-70

WHAT IS CLAIMED IS:

1. Potato flakes having from 16% to 26.5% amylose a Water absorption index from 6.7 to 9.5 g of water/g of flakes and sheet strength value of 140 to 250 gf; wherein said potato flakes are made from potato pieces comprising from 5% to 100% nubbins, slivers and mixtures thereof and from 0% to 95% of other potato pieces.

2. The potato flakes of Claim 1 wherein said flakes are made from 20% to 80% slivers and nubbins said flakes having from 0.1% to 0.5% emulsifier and from 5% to 10% moisture.

3. The potato flakes of Claim 1 or 2 wherein said percent amylose is from 16% to 20%, said water absorption index is from 6.7 to 8.3 g of water/g of flakes and said potato dough sheet strength is from 140 to 200 gf, wherein said potato flakes have from 40% to 60% broken cells; and wherein from 20% to 40% of said potato flakes remain on a #40 U.S. screen.

4. The potato flakes of Claim 1, 2 or 3 wherein said potato flakes have a moisture content from 6% to 8%, wherein said flakes are made from potato pieces containing 30% to 40% slivers and nubbins.

5. The potato flakes of Claim 1 wherein said flakes are made with 100% slivers and nubbins.

6. A method of making the potato flakes of Claim 1, 2, 3, 4 or 5 comprising:
   (a) cooking and mashing potatoes pieces comprising said nubbins and slivers at a steam pressure of from 2 to 20 psig and a residence time of 15 to 65 minutes;
   (b) adding from 0.1% to 1% emulsifier to the cooked and mashed potato pieces of step (a);
   (c) drying and flaking the cooked and mashed potato pieces; and
   (d) cutting the dried and flaked potatoes to a particle size wherein from 25% to 35% are retained on a 40 mesh U.S. screen.

7. A method according to Claim 6 wherein said cooking time is from 16 to 25 minutes; and wherein said pressure is from 3 18 psig.

8. A method according to Claim 7 wherein said emulsifier is added at a level of from 0.1 to 0.5%.

9. A method according to Claim 8 wherein said potato flakes are made from a mixture comprising from 30% to 40% nubbins and slivers and from 70% to 60% potato slices.

10. A sheetable snack food dough comprising from 45% to 70% of the potato flakes of Claim 1, 2, 3, 4 or 5; at least 3% hydrolyzed starches having a DE of from 5 to 30; from 0.5% to 6% emulsifier; and from 20% to 40% added water.

11. A fabricated chip made from the dough of Claim 10 wherein said dough is cut into snack food pieces and fried to provide said fabricated chip.

12. The fabricated chip of Claim 12 wherein said chip is fried in a nondigestible fat.

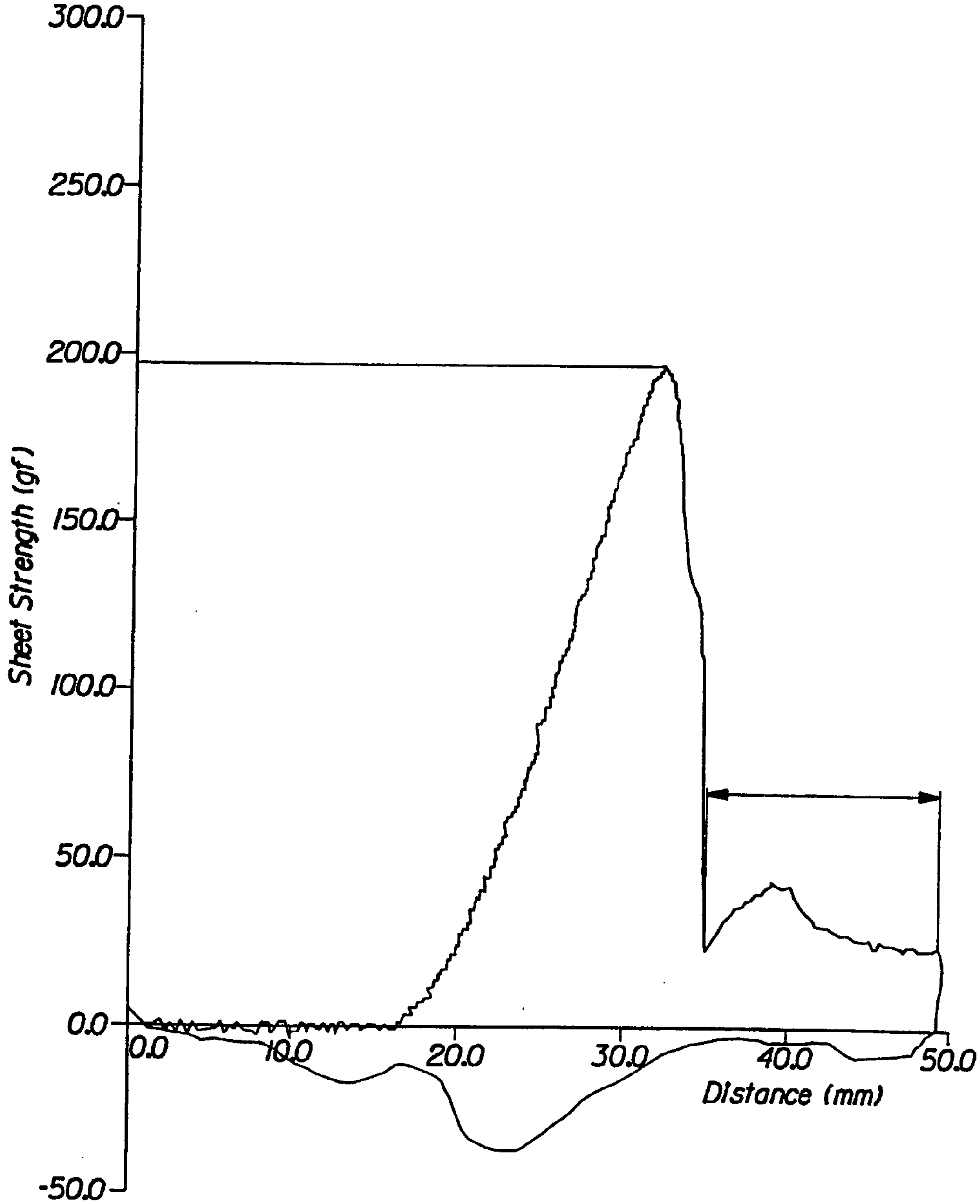
300.0
250.0
200.0
150.0
100.0
50.0
0.0
-50.0
Sheet Strength (gf)
0.0
10.0
20.0
30.0
40.0
50.0
Distance (mm)

Fig. 1

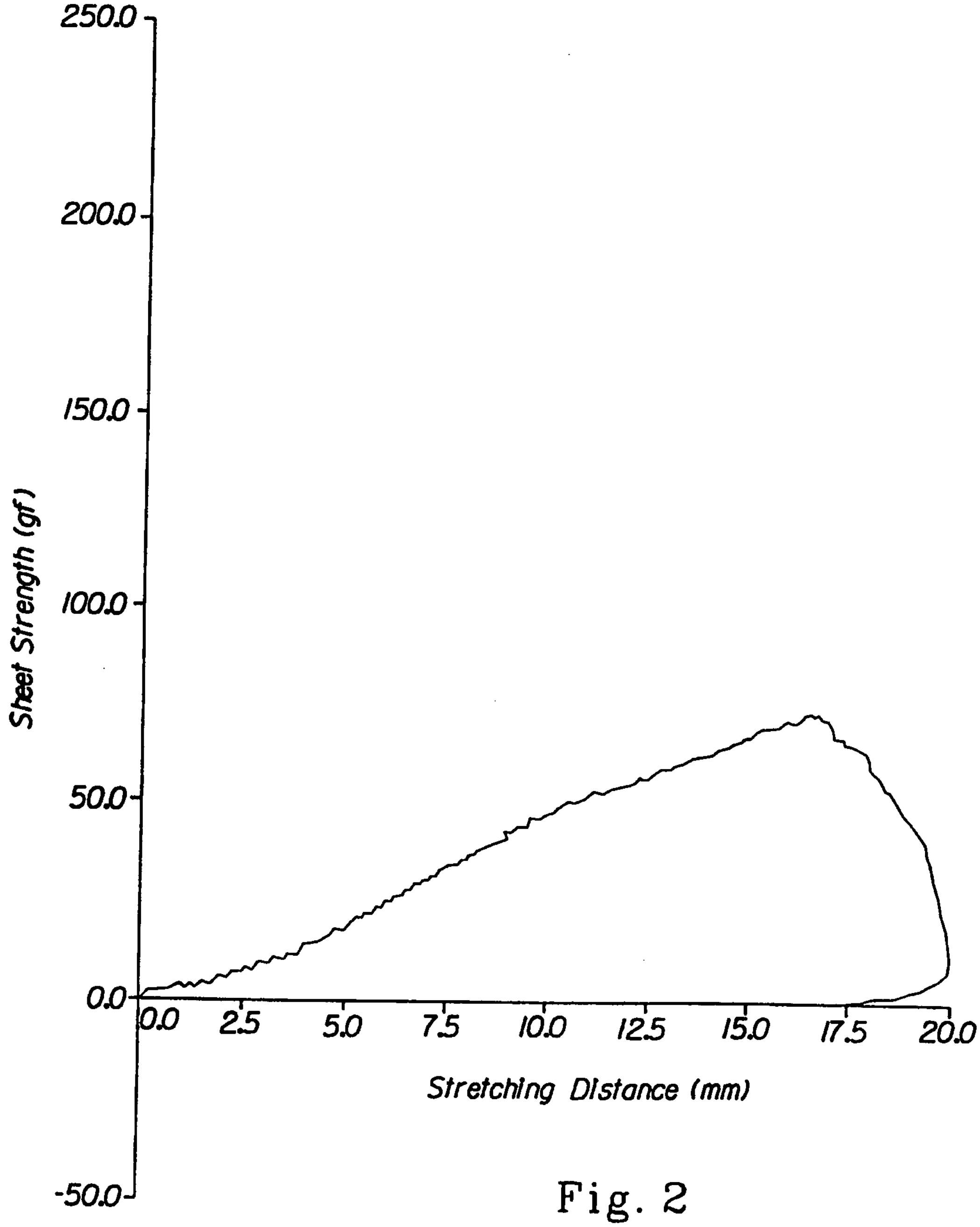
250.0
200.0
150.0
100.0
50.0
0.0
-50.0
Sheet Strength (gf)
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Stretching Distance (mm)

Fig. 2

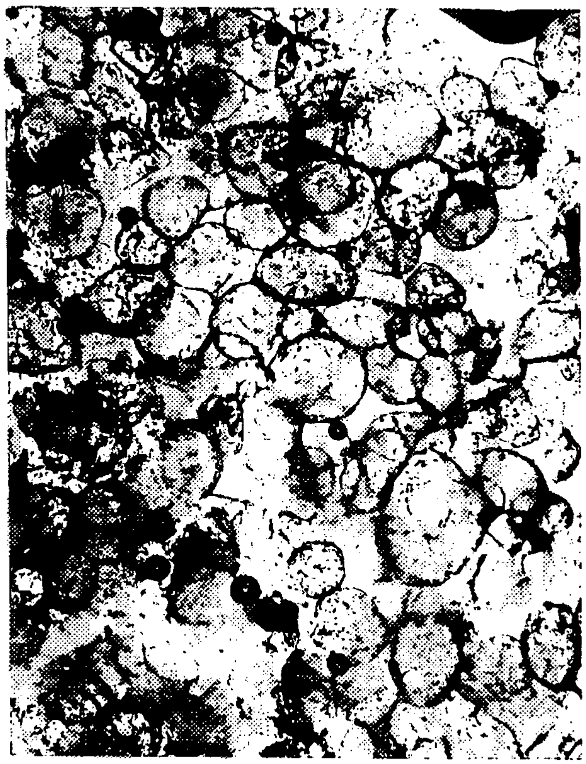

Fig. 3

Fig. 4

INTERNATIONAL SEARCH REPORT

In. .tional Application No
PCT/US 97/12693

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A23L1/2165 A23L1/217

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A23L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	W.F. TALBURT, O.SMITH: "Potato Processing" 1975 , AVI , USA XP002044656 Pages 467-469, 472-489 see page 467, paragraph 2 see page 468, paragraph 5 - page 469, paragraph 2 see page 474 - page 489 ---	1-12
X	AU 77546 75 A (PILLSBURY CO) 29 July 1976 see claims 1,2 see page 4, paragraph 2 - page 5, paragraph 1 see page 6, paragraph 7 - page 8, paragraph 2 see page 13, paragraph 3 see example 1 --- -/--	1-12

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

1

Date of the actual completion of the international search 27 October 1997	Date of mailing of the international search report 11. 11. 97
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Vuillamy, V

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INTERNATIONAL SEARCH REPORT

In. ational Application No
PCT/US 97/12693

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 355 304 A (J.A. BARNES) 28 November 1967 see column 5, paragraph 4 ---	2,4
X	WO 96 01572 A (PROCTER & GAMBLE) 25 January 1996 see page 2, line 5 - line 31 see page 5, line 1 - page 6, line 14 see page 7, line 25 - page 9, line 16 see page 1 ---	1-12
X	US 5 429 834 A (ADDESSO KEVIN ET AL) 4 July 1995 see column 5, paragraph 2 see column 6, paragraph 3 see column 7, paragraph 6 see column 11, paragraph 4 see example 1 ---	1-12
X	US 5 464 642 A (VILLAGRAN MARIA D ET AL) 7 November 1995 see column 3, line 50 - column 6, paragraph 2 see examples 1-4 -----	1-12

1

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 97/12693

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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WO 9601572 A	25-01-96	AU 2860795 A	09-02-96
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